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THE

MECHANICAL TREATMENT

OF THE MORE COMMON

Abnormal Conditions of the Foot.

BY

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CHARLES FREDERICK STILLMAN, M. S., M. D.
PLAINFIELD, N. J.

(Late House Surgeon of St. Francis' Hospital, New York.)



Extracted from the Transactions of the Medical Society of New Jersey.

L. J. Hardham, Printer, Newark, N. J.

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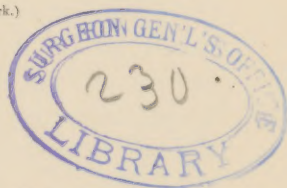
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ESSAY.

BY CHARLES F. STILLMAN, M. D., OF PLAINFIELD, N. J.

THE MECHANICAL TREATMENT OF SOME OF THE MORE COMMON ABNORMAL CONDITIONS OF THE FOOT.

Every surgeon in large practice has many cases brought to his notice of weak ankles, inverted feet, and the commoner forms of club foot, which are not sufficiently grave to need operative procedure, and for which our mechanical contrivances have hitherto proved crude and insufficient, because not strictly physiological. It will be my aim in this short paper, to lay before you a plan of treatment differing in many points from any in use, avoiding all pathological and anatomical descriptions, except those which are necessary to the proper understanding of the mechanical treatment, as this department alone is embraced by our subject.

WEAK ANKLES.

The foot is made up of twelve bones, which, in the normal condition, are held closely and harmoniously together, and may be considered, as far as the ankle is concerned, as one piece, since only one of its bones, the astragalus, comes in contact with the bones of the leg, this articulation constituting the ankle joint. This joint

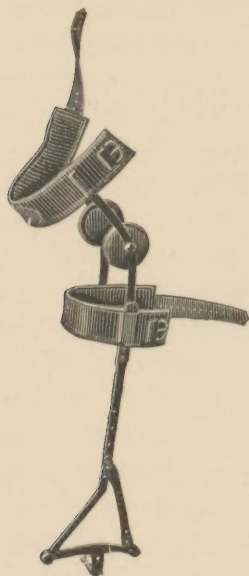
permits of "two free and two limited movements" of the foot—extension and flexion, and inward and outward rotation. The foot is retained at its proper angle by a series of muscles, so exquisitely adjusted that a perfect balance of power exists between them; but let this balance be destroyed, and the harmony of the arrangement is lost and deformity occurs.

The loss of power in the muscles may be limited to one or several, or may embrace them all. The greater number of cases, however, are those in which the anterior muscles of the leg are impaired, the predominant symptom being a dropping of the foot, the anterior half more than the posterior, with diminution of power to keep the foot at a right angle, or to lift the toes while walking. When this is not complicated with changes in the structure of the foot, the latter may either invert or evert as chance may direct, but the tendency is to invert in the majority of cases. The external and internal supports are also weakened, and the ankle gives way laterally, especially externally, on the smallest provocation.

The treatment of the uncomplicated condition is mechanical and physiological. The mechanical treatment consists in supplying, as far as possible, the muscular power of the anterior of the leg, treating the foot as a whole, giving at the same time lateral support. It is then necessary to use a brace, which will allow all the motions of the ankle joint, and yet be provided with constant elastic power of sufficient force to keep the foot at a right angle when at rest, and afford the extended muscles a chance to contract and revive under the influence of the physiological treatment.

I have devised for this purpose a brace which fulfills these conditions, and fulfills them perfectly, and supplies a want long felt in Orthopedic surgery, for an apparatus

which can be worn with the patient's ordinary shoes, and yet be detachable at pleasure. It consists of a steel strip, parallel with the leg, and worn externally, so as to



interfere less with locomotion, and be opposed to the side towards which flexion takes place; connected above with a leg girth, and extended below at an angle to the back of the heel, where it is hinge-jointed with a horizontal strip whose anterior extremity is connected with the vertical strip above the point of divergence by an elastic cord, which may be lengthened or shortened at will.

The horizontal strip is rivited to a strong strip passing under the instep, perforated in the centre to allow the insertion of an oblong pin attached to a plate, fastened into the arch of the shoe. This pin may be turned around after such insertion, and then forms both a firm attachment and a pivot, and is situated in the centre of motion of the foot.

The points for which I assume originality and excellence in this arrangement are:

1st. Placing the hinge-joint at the back of the heel, instead of over the ankle joint, as in every other form of apparatus, thus greatly increasing the leverage, and, in connection with elastic power anteriorly which may be augmented as desired, preventing the toes from dropping beyond a desired line, producing a constant elastic power vertically, which causes the foot to assume any desired angle with the leg.

2d. Making the brace and shoe distinct and connecting

the brace with the shoe only by a detachable pivot in the centre of motion of the foot, and to the leg by a girth, allowing it to be removed at pleasure.

The pivot insertion below allows the foot to be everted or inverted at will, without in the least impairing the support of the ankle; and any apparatus like those now in use, which allows motion of the foot only upwards and downwards, does not fulfill the indications.

The phrase "centre of motion of the foot," deserves a little explanation. If you stand upon one foot, and raise the other from the floor sufficiently to suspend it from the hip, rotating it slowly inwards and outwards, both heel and toe describe arcs of circles of different diameters. Now, while the foot is rotated outward, pass an imaginary line bisecting it longitudinally, and when inward, pass another imaginary line bisecting it, and the point of intersection of these two bisecting lines is the centre of motion of the foot—a line passing through this point and hip joint being the line of direction of the leg. So that the centre of motion is the proper point to place a pivot if you wish lateral or rotary motion of a foot in the highest degree, with no opposition, and therefore the pivot of our brace is placed in that position.

INVERTED FEET.

This affection is an exceedingly common one among children, who are generally designated as pigeon-toed, and causes an extremely awkward gait. It is due to a weakened condition of the peronei muscles, which possess the power of everting the foot, and may be either congenital or non-congenital, the former being much the more common and difficult to treat. In its more advance stages it constitutes the various types of Talipes Varus. In simple uncomplicated inverted feet, the de-

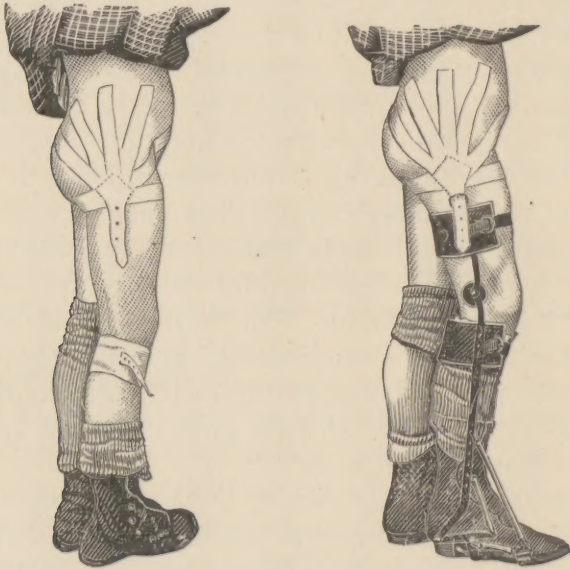
formity is slight, the patient being able to wear an ordinary shoe, the weight of the body keeping it in shape, but the toes point inward and downward, both at rest and in motion.

While the impaired muscles are being treated by electricity, friction, etc., to restore their tone, it becomes necessary for us to use a mechanical appliance to restore the balance of power, to diminish the extra contractility of the antagonistic muscles, to keep the foot at its natural angle with the leg, and to evert it. This is done by adding to the brace just described under the head of weak ankle, an adjustable elastic cord extending from the outside of the shoe, opposite the little toe, to the instep strip of the brace. This everts the foot to any desired degree, dependent upon the length and strength of the elastic, provided the pivot is situated in the centre of motion of the foot, and that the girth about the leg be so fixed that it cannot rotate.

This is accomplished in one of three methods, viz: 1st. The girth may be broad and furnished with elastic straps which grasp the limb firmly. This is sufficient in a great majority of cases. Or, 2d. The side strip is provided with an oblong pelvic band, with joints at the knee and hip. Or, 3d, By making two fixed points on the limb by means of strong moleskin adhesive plaster. One of these is to be fixed upon the thigh and the other upon the leg, or a single one upon the leg.

The thigh attachment is made as follows: A square piece of the adhesive plaster is cut in the shape shown in the drawing, and to the centre is sewn a perforated leather tongue, which is to pass through a buckle on the thigh girth of the brace. The object of this thigh attachment is to make it impossible to adduct the foot when the brace is worn.

The object of the leg attachment is to prevent the girth from slipping around, as when this occurs the action of the everting cord is destroyed. A piece of adhesive plaster is cut in the shape shown in the drawing, and a



leather tongue attached to the pointed extremity, after being fastened to the leg. When the brace is applied, this tongue passes into the buckle of the girth, together with the tongue of the girth, effectually preventing rotation, as the one buckle holds two tongues, one fastened to the leg and the other to the girth, and each pulling in a contrary direction. These two immovable adhesive attachments afford us the fixed points we require in obstinate cases, and allow us to use a constant elastic power to relieve the super-contraction of the opposing muscles, while relieving the over-distended ones to which the deformity is mainly due, giving us the opportunity to restore these by physiological treatment.

TALIPES EQUINUS.

When the insufficiency of the anterior muscles is associated with the contraction of their antagonists, we have induced the condition known as Talipes Equinus.

When not complicated by structural changes among the bones of the foot itself, this may be reduced by the brace just described, with the addition of two elastic cords passing from a point in the side strip near the girth to points on the sole opposite the bases of the great and little toes, of sufficient strength. But when associated with structural changes among the bones of the foot, so that the foot cannot be restored to its normal shape without operative or mechanical interference, I would suggest the use of a fixed instead of an elastic power, to effect the gradual reduction. This can be done by means of an adjustable bracket, of the form shown, fixed to the foot and leg by immovable attachments.

I devised this bracket several years ago, for a contraction of the arm at the elbow, which it succeeded in extending by gradual adjustment, and it is with great confidence that I urge its claims here as being mechanically adapted for the treatment of the condition described.



Our first aim must be to restore the proper lines of the foot as a whole, by reducing it to its proper position as near as can be, without tenotomy, if possible, and then fixing it in this position by some firm inflexible dressing, as plaster-of-Paris, or the adhesive plaster and flour paste dressing. This must also be applied to the leg.

The bracket is applied as follows, when used with the adhesive plaster and flour paste dressing :

The foot and leg are to be sheathed longitudinally by strips of strong moleskin adhesive plaster, placed about one quarter of an inch apart, and encircled by other strips, the ankle joints and vicinity being uncovered. The clamps of the bracket are then loosened, and it is adjusted upon the foot and leg, the terminal plates being bound down firmly by broad bands of adhesive plaster of sufficient length. A little flour and cold water are now mixed together to a creamy consistence, and smeared over the nap of the adhesive plaster, and rollers of unbleached muslin applied, the smearing still being continued until several thicknesses of the bandage are in place. When this dries, which will be after a short interval, we have a firm, well-fitting attachment which suffers no subsequent expansion or contraction, as does plaster-of-Paris, and holds the bracket in just the desired position.

At the next visit the surgeon is to flex the foot strongly, the clamps of the bracket being loosened, and when a desired amount of the contraction has been overcome,



the clamps are to be tightened, and at that angle the foot will remain until his next attempt. This can be repeated as often as necessary, until the contracted muscles are gradually stretched to nearly their normal calibre, when

the elastic brace already described may be used until the cure is entirely perfected.



This method of treatment substitutes a gradual reduction of the deformity for the quick reduction by operation, and although it takes longer to produce the desired effect than it does by tenotomy, is in many cases advisable, since the objection of the laity to the knife is very great, in fact, among the laboring classes, there is a superstition that one whose heel tendon is cut, whether by accident or operation, does not survive many years.

TALIPES VARUS.

This is an exaggeration of the condition already described under the head of inverted feet, and in it the mediotarsal joint referred to under the head of Talipes Equinus, plays a very important part, since the tendons of all the muscles of the leg, not connected with the Tendo Achilles are inserted anterior to it.

In well marked cases, especially of the Equino-Varus, which is much the more common form, the foot is bent sharply in the middle, and the limb is "twisted" (Barwell)

laterally, the sole looking backwards, the patient almost walking upon the outer malleolus.

The mechanical treatment is founded upon the idea of aiding and restoring the normal relations of the foot in its different parts, and the balance of power in the muscles of the leg. Any foot that is not so distorted but that it can be brought into its normal shape and relations by the hand of the surgeon, by bandaging, whether flexible, adhesive or immovable, by the use of my bracket and fixed dressing, by any extension shoe, or by tenotomy, or so nearly so that it can be inserted into an ordinary shoe, can be cured by the attachment of my club foot brace to such a shoe, for it combines in itself the essential principles of the most effective methods of treatment.

Let us look for a moment at the construction of an ordinary shoe, such as we buy at any shoe shop. It is built on a wooden model of the normal foot, and is of great strength and flexibility. Let us look for a moment at the sole of such a shoe. Grasp the toe with one hand and the heel with the other and twist it. It will be seen that the twisting takes place anterior to the situation of the mediotarsal joint, and that this part of the shoe is very flexible and yet very elastic; that when you let it go, it will resume its previous shape. If you now put a club foot in such a shoe, although the shoe is correct in shape, it immediately becomes distorted, because the power of the contraction which the foot has undergone is greater than the inherent power of the shoe to retain its shape. But if you supply the place of the weakened muscles by elastic cords of sufficient strength to overcome the extra contraction of the antagonistic muscles and attach these appropriately to the shoe, the sole is converted into a powerful, elastic spring, which is, at the same time, a firm support.

Let us, for a moment, glance at the Sayre club foot shoe. It has a rigid sole, divided transversely opposite the mediotarsal joint, and connected by a ball and socket joint which admits of the greatest mobility in every direction. It is not physiological, although more correct than any form of shoe that had preceded it, for there is nothing in this part of the foot to correspond to such a joint, the limited articulations of the foot allowing very little motion in the arch, although much more anterior to this. In fact, it will be noticed that the degree of movement allowed by the sole of the foot corresponds very closely to that allowed by the leather sole of the shoe, which can be twisted by the hands to correspond to the sole of the foot in the worst cases of club foot—if the upper part of the shoe be divided from the toe to the ankle—and since the sole of the foot is continuous and not split across, although *twisted* in club foot, it naturally follows that the surface to lie against it should possess the same qualifications, if we wish most perfect ease and reduction.

And yet this ball and socket shoe is far superior to the Scarpa shoe. The great advantage of the leather continuous sole is, that if it be properly controlled by elastic cords, corresponding to the weakened muscles, and fastened firmly and evenly on the foot, as it must be if encased in a well fitting shoe, as this is not elastic, it will exert a constant spring action which is both a support and an agent of reduction, exactly in proportion to the amount of contractive deformity of the foot, and yet, as it is continuous with all the twists and sinuosities of the foot, does not impinge or cause discomfort or produce undue pressure on any particular part. It combines the merit of the continuous soles of the various shoes, without their demerit of rigidity, with sufficient flexibility of

the anterior portion of the Sayre shoe compared with the posterior without its extreme and unphysiological mobility. No club foot *shoe* is physiological without the ball and socket joint, but in the club foot *brace* we are enabled to dispense with this as well, and have more physiological control over the foot itself.

In a previous description of the rigid part of the brace, we have seen that it has but one *fixed* attachment to the leg below the knee, and that by a girth about the upper part of the calf of the leg, corresponding to the origin of the muscles, and one *movable* attachment by a pivot in the centre of motion of the foot, so that beyond protecting the ankle joint and stiffening the shoe from the heel to the mediotarsal joint by the arch plate, to which is attached the pivot, these fastenings possess no regulating power over the foot in the least, except when the shoe be attached to the brace by rubber cords.

Now let us look at the uses of the three elastic cords attached to the club foot brace.

1. The cord passing from the extremity of the horizontal strip to the angle of divergence in the vertical strip controls the extension of the foot at the ankle joint, and acts against extra contraction of the tendo achilles.

2. The everting cord passing from the instep strip to the toe of the shoe opposite the base of the little toe, acts in place of the peroneus brevis, having practically its origin in the immovable girth about the calf and its insertion in the sole considerably anterior to the mediotarsal joint, giving it a tremendous everting power if the girth be fixed immovably as already detailed.

3. The abducting and rotating cord passes from the base of the little toe to a point in the brace near the girth, supplying the place of the peroneus longus, and acting against the anterior and posterior tibial muscles,

whose contraction causes the deformity, and as it is inserted at a point in the sole which is really the apex of the deformity, a power is exerted in exact proportion to the length and strength of the elastic tubing, twisting the anterior half of the foot directly contrary to the tendencies of the contraction.

My elastic brace is really a combination of the essential principles of the various club foot shoes with the essential principles of Barwell's system of elastic muscles. It possesses the very great advantage over Barwell's system of instant removability, being taken off and put on at pleasure, and furnishing at the same time, which Barwell's does not, an articulated, firm support on the outside of the leg, preventing the ankle from turning. It allows the patient to wear a close fitting, easy shoe, as in a normal foot, and has no constriction or encirclement of the limb or foot other than the shoe, below the girth about the calf, allowing all the natural movements of the foot full play, simply assisting Nature's efforts to guide these in their proper direction. It is light, inexpensive and lasting, and may be readily attached to any shoe.

The weight of the body is the most powerful agent for good or bad which we have in the treatment of club foot, and the most important factor, also, in its production. If the relations of the foot are wrong, the weight of the body tends to increase the deformity, but if, by an elastic retentive apparatus, we can put the foot into its normal relations, the weight of the body tends to press out the angularities and keep it in proper shape by a power just in proportion to the weight of the person and the amount of walking and running that is done. This is one of the best features of my elastic brace, that it not only allows but actually assists the walking, and consequently is a powerful agent for permanent cure.

Now, if the lateral twist of the foot at the mediotarsal articulation be so great and so unyielding that it cannot be placed in an ordinary shoe or conform to the shape into which the sole can be twisted, it must be treated by either operative or mechanical means until it can do so, when it is to be placed in the elastic brace until the cure is complete.

The mechanical treatment consists in restoring the relations of the foot, whether by the hand of the surgeon, by bandaging, by massage and general manipulation, and the retention, between such applications, in some fixed dressing, as the flour-adhesive or plaster-of-Paris, applied and allowed to set while the foot is being held in, as nearly as possible, its normal position. It also consists in restoring the balance of power in the leg by reducing the extra contraction with the adjustable bracket before described. Cutting the tendons may be resorted to when desired, but it seems to me that the use of this bracket will, by the substitution of a gradual for an operative procedure, diminish the frequency of the operation with its attendant evils.

This chapter may also be considered as a guide to principles governing the treatment of Talipes Valgus, as the only difference consists in the arrangement of the elastic cords, to be detailed more fully hereafter.



